机器学习部分-大作业要求及可选数据集介绍

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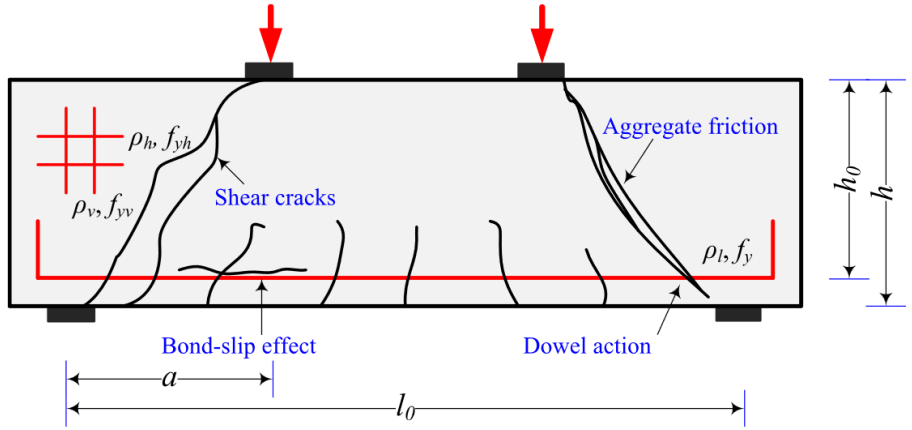
2024年10月25日

大作业要求（线上上课的工程博士自愿选做）

- 10月30日完成分组：4~5人一组，建议5人
- 内容： 每组选取至少3个数据集（不限于所提供数据集），优化不同的算法 (至少4种, 其中回归、分类、聚类至少涉及2种)，建立机器学习模型并比较模型效果，可解释各feature的重要性。
  - Linear, and Lasso, Ridge, Elastic Net
  - Logistic Regression
  - Decision Tree
  - Random Forests
  - Gradient Boosting Decision Tree, XGBoost, LightGBM, AdaBoost, etc.
  - Neural Network
  - Support Vector Machine
  - K-Nearest Neighbors
  - K-means
  - ……
- 展示：PPT讲解，每组XX分钟（具体时间按分组情况定）。
- 提交：代码与PPT （打包命名为“组号_姓名.rar/zip”，如#2_赵一_刘二_张三_李四_王五.rar/zip 一位组员代表提交到Canvas系统的“作业”—— 机器学习大作业提交。截止时间：汇报前一天23:59)

数据集1：RC深梁的抗剪强度预测



Dataset (Size: 272)

#	l0	h	h0	b	a	l0/h	a/h0	pl	fyl	ph	sh	fyh	pv	sv	fyv	fc'	Vu
1	1500	750	690.11	100	500	2	0.72	1.82	210	0	0	0	0	0	0	21.45	249.9
2	2000	560	500	130	625	3.57	1.25	1.56	410	0.43	101.25	410	0.12	362.82	410	49.1	347.1
3	2000	560	500	130	425	3.57	0.85	1.56	410	0.43	101.25	410	0.12	362.82	410	23.7	284.05
4	762	508	470	76	254	1.5	0.54	0.79	286.8	0	0	0	2.45	76	279.9	21.2	190
5	2500	500	462.96	110	1250	5	2.7	1.23	504.8	0	0	0	0.48	300	375.2	42.8	105
6	940	356	305	102	368	2.64	1.21	1.94	431	0.91	69.9	437.4	0.42	152.4	437.4	19.8	145.2
7	813	356	305	102	305	2.28	1	1.94	431	0.23	139.7	437.4	0.28	228.6	437.4	18.7	161.2
8	1829	457	390	203	610	4	1.56	3.1	320.6	0	0	0	0.34	203	331.1	44.7	434.9
9	4065	915	718	305	915	4.44	1.27	1.4	420	0.13	304.8	450	0.31	152.4	450	32	1134
10	750	750	691.97	100	250	1	0.36	1.47	210	0.57	100	210	0.57	100	210	25.02	411.6
11	1829	457	390	203	457	4	1.17	1.63	335.3	0	0	0	0.61	114.3	331.1	25.9	312.2
12	1829	457	390	203	457	4	1.17	1.63	335.3	0	0	0	1.22	57.2	331.1	23.1	312.2
13	940	356	305	102	368	2.64	1.21	1.94	431	0.91	69.9	437.4	0.24	266.7	437.4	19.5	153.4
14	1829	457	390	203	610	4	1.56	2.07	320.6	0	0	0	0.69	101.6	331.1	24.1	323.7
15	1829	457	390	203	762	4	1.95	3.1	320.6	0	0	0	0.73	95.3	331.1	23.2	301.1
16	2000	560	500	120	625	3.57	1.25	1.29	410	0.23	205.07	410	0.13	362.82	410	50.7	260.4
17	762	254	216	76	254	3	1.18	1.73	286.8	0.86	152	303.4	0	0	0	22.6	96
18	762	254	216	76	254	3	1.18	1.73	286.8	2.45	76	279.9	0	0	0	22.6	87
19	2500	560	500	130	425	4.46	0.85	1.56	410	0.43	101.25	410	0.12	362.82	410	49.1	567.45
20	1500	750	688.56	100	500	2	0.73	2.85	210	0	0	0	0	0	0	22	303.8
21	2000	500	462.96	110	1000	4	2.16	1.23	504.8	0	0	0	0.48	300	375.2	41.1	150
22	1500	750	690.11	100	500	2	0.72	1.82	210	0	0	0	0	0	0	24.55	352.8
23	1500	500	446	100	690	3	1.55	0.23	382	0.51	70	454	0.22	160	454	24.49	78
24	1118	356	305	102	457	3.14	1.5	1.94	431	0.45	69.9	437.4	0.18	355.6	437.4	21.9	123.4
25	900	900	837.5	100	390	1	0.47	1.17	330	0.35	100	454	0.21	170	454	28.05	485
26	1829	457	390	203	762	4	1.95	3.1	320.6	0	0	0	0.73	95.3	331.1	26.3	322.2
27	2000	560	500	130	250	3.57	0.5	1.56	410	0	0	0	0	0	0	49.1	642.2
28	1829	457	390	203	457	4	1.17	1.63	335.3	0	0	0	0.46	152.4	331.1	26.1	356.7
29	2000	560	500	120	625	3.57	1.25	1.29	410	0.94	50.18	410	0.13	362.82	410	73.6	333
30	1500	500	462.96	110	750	3	1.62	1.23	504.8	0	0	0	0.48	300	375.2	50.6	220
31	690	508	476.25	76.2	216	1.36	0.45	0.55	317	0	0	0	0	0	0	21.31	184
32	750	750	691.97	100	250	1	0.36	1.47	210	1.12	90	210	1.12	90	210	23.31	360.15

Feature (Input Variables)

类别	变量符号（单位）	描述
几何尺寸	l_0(mm)	梁跨长度(beam span)
	h(mm)	梁高(height)
	h_0(mm)	有效高度(effective height)
	b(mm)	梁宽(width)
	a(mm)	剪切跨度(shear span)
	l_0/h	跨高比(beam span-to-height ratio)
	a/h_0	剪切跨深比(shear span-to-depth ratio)
纵筋信息	ρ_l(%)	配筋率(reinforcement ratio)
	f_{yl}(MPa)	纵筋强度(reinforcement strength)
腹板配筋信息	ρ_h(%)	水平配筋率(horizon reinforcement ratio)
	s_h(mm)	水平配筋间距(horizon reinforcement spacing)
	f_{yh}(MPa)	水平配筋强度(horizon reinforcement strength)
	ρ_v(%)	竖向配筋率(vertical reinforcement ratio)
	s_v(mm)	竖向配筋间距(vertical reinforcement spacing)
	f_{yv}(MPa)	竖向配筋强度(vertical reinforcement strength)
混凝土强度	f_c'(MPa)	混凝土抗压强度(concrete strength)

Target (Output Variables)

变量符号（单位）	描述
V_u(kN)	梁的抗剪强度(shear strength of the beams)

数据集2：RC墩柱破坏模式预测

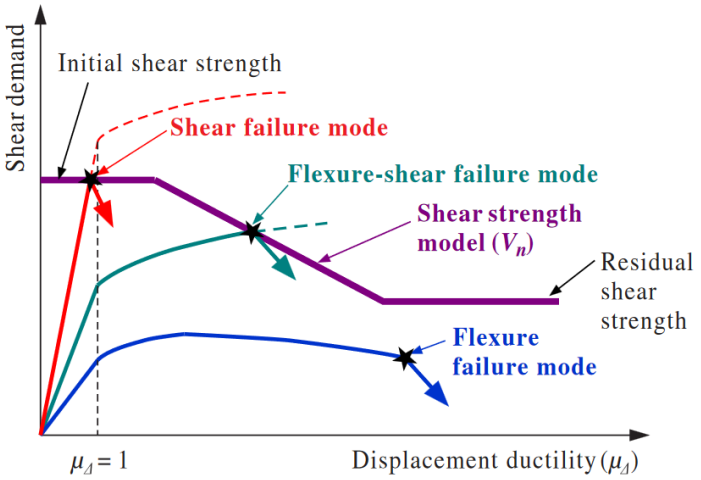


Fig. 1. Typical definition of column failure modes.

Dataset (Size: 311)

#	Test configuration	Section shape	Hoop type	f_c' (MPa)	f_y (MPa)	f_{yh} (MPa)	a/D	s/D	$P/(f_c'A_g)$	ρ_l (%)	ρ_s (%)	Failure Mode
1	Cantilever	Octagonal	Spiral	33.2	373.0	312.0	5.50	0.13	0.055	2.57	0.43	Flexure
2	Cantilever	Octagonal	Spiral	34.8	371.0	312.0	3.50	0.13	0.053	2.57	0.43	Flexure
3	Cantilever	Octagonal	Spiral	33.8	373.0	342.0	6.50	0.13	0.054	2.57	0.43	Flexure
4	Cantilever	Octagonal	Spiral	40.0	305.0	389.0	5.46	0.07	0.003	2.57	1.23	Flexure
5	Cantilever	Octagonal	Spiral	35.1	305.0	263.0	5.36	0.06	0.011	2.56	1.82	Flexure
6	Cantilever	Octagonal	Spiral	33.0	294.0	207.0	3.72	0.04	0.322	2.18	2.42	Flexure
7	Cantilever	Octagonal	Spiral	26.0	308.0	308.0	4.00	0.10	0.197	2.43	0.74	Flexure
8	Cantilever	Octagonal	Spiral	28.5	308.0	280.0	4.00	0.14	0.559	2.43	1.50	Flexure
9	Cantilever	Octagonal	Spiral	28.4	303.0	300.0	2.00	0.13	0.227	2.43	0.73	Flexure
10	Cantilever	Octagonal	Spiral	32.9	303.0	423.0	2.00	0.12	0.386	2.43	0.78	Flexure
11	Cantilever	Octagonal	Spiral	32.5	307.0	280.0	2.00	0.09	0.349	2.43	2.56	Flexure
12	Cantilever	Octagonal	Spiral	32.5	307.0	280.0	2.00	0.09	0.698	2.43	2.56	Flexure
13	Cantilever	Circular	Spiral	29.9	448.0	372.0	2.50	0.08	0.200	3.20	0.99	Flexure
14	Cantilever	Octagonal	Spiral	32.3	337.0	466.0	4.00	0.34	0.130	2.43	0.61	Flexure
15	Cantilever	Octagonal	Spiral	27.0	337.0	466.0	4.00	0.19	0.580	2.43	1.10	Flexure
16	Cantilever	Octagonal	Spiral	40.0	474.0	372.0	4.00	0.21	0.500	1.82	0.62	Flexure
17	Cantilever	Octagonal	Spiral	39.0	474.0	338.0	4.00	0.14	0.700	1.82	1.44	Flexure

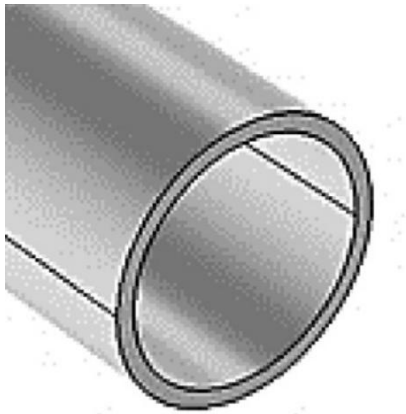
Feature (Input Variables)

变量符号	描述
Test configuration	试验约束条件：一端约束(Cantilever, 1)或两端约束(Double curvature, 2)
Section shape	截面形状：圆形(Circular, 1)或八边形(Octagonal, 2)
Hoop type	箍筋约束形式：螺旋箍(Spiral, 1)或圆形箍(Circular, 2)
$f_c'A_g$(MPa)	混凝土抗压强度 Concrete compressive strength
f_y (MPa)	竖向主筋屈服强度 Yield strength of longitudinal reinforcement
f_{yh} (MPa)	箍筋屈服强度 Yield strength of transverse reinforcement
a/D(/)	长细比 Aspect ratio
s/D(/)	箍筋间距与墩径之比 Hoop spacing to column diameter ratio
$P/f_c'A_g$(/)	轴压比 Axial load ratio
ρ_l	配筋率 Longitudinal reinforcement ratio
ρ_s	配箍率 Transverse reinforcement ratio

Target (Output Variables)

变量符号	描述
Failure Mode	弯曲 Flexure (1)；弯曲-剪切 Flexure-shear (2)；剪切 shear (3)

数据集3：老旧管道破坏压力预测



Dataset (Size: 92)

#	D/mm	t/mm	L/mm	d/mm	YS/MPa	UTS/MPa	Popt/MPa	FP/MPa
1	459	8.1	40	5.4	601	684	17	23
2	459	8	40	3.8	589	731	16.4	24
3	324	9.8	256	7.1	452	542	21.9	14
4	324	9.7	306	6.8	452	542	21.7	14
5	324	9.7	350	6.9	452	542	21.7	14
6	324	9.7	395	6.9	452	542	21.7	13
7	324	9.9	433	7.3	452	542	22.1	12
8	324	9.7	467	7	452	542	21.7	12
9	324	9.8	489	7	452	542	21.9	12
10	324	9.8	500	7	452	542	21.9	12
11	324	9.7	528	7.1	452	542	21.7	11
12	508	14.6	500	10.4	478	600	22	15
13	508	14.3	500	10.3	478	600	21.5	13
14	508	14.8	500	9.7	478	600	22.3	16
15	508	6.6	381	2.6	540	610	11.2	11
16	508	6.4	900	3.4	540	610	10.9	8

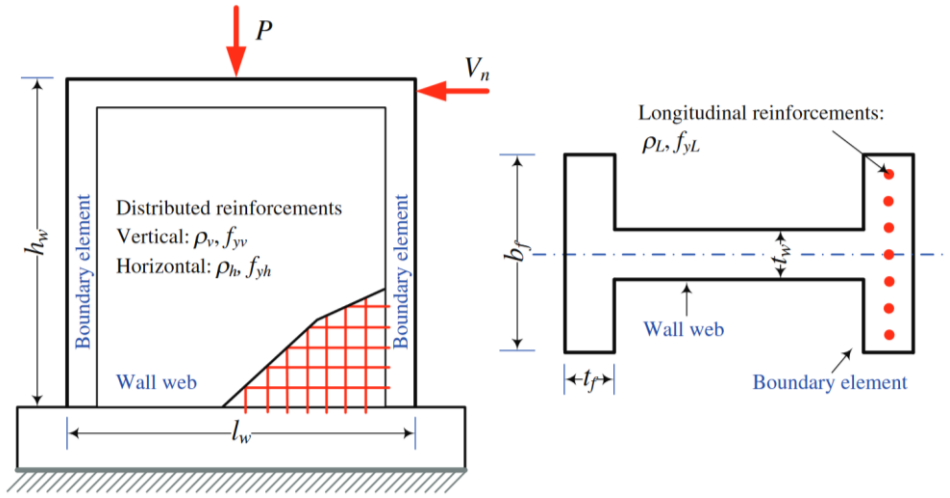
Feature (Input Variables)

变量符号（单位）	描述
D(mm)	直径(diameter)
t(mm)	厚度(thickness)
L(mm)	腐蚀长度 (length of corrosion defect)
d(mm)	腐蚀深度 (depth of corrosion defect)
YS(MPa)	屈服强度 (Yield Strength)
UTS(MPa)	极限抗拉强度 (Ultimate Tensile Strength)
$Popt$(MPa)	工作压力 (Operating pressure)

Target (Output Variables)

变量符号（单位）	描述
FP (MPa)	破坏压力 Failure pressure

数据集4：RC矮墙抗剪强度预测



Dataset (Size: 434)

#	hw	lw	tw	bf	tf	fyv	fyh	fyL	fc'	ρv	ρh	ρL	P	Vu
1	750	2250	80	250	250	623.7	623.7	358.9	26	0.0049	0.0047	0.0081	369.7	654.1
2	750	2250	80	250	250	623.7	623.7	358.9	24.6	0.0016	0.0014	0.0081	367.5	559
3	750	2250	80	250	250	623.7	623.7	358.9	26	0.0016	0.0014	0.0081	369.7	524.7
4	750	2250	50	250	250	623.7	623.7	358.9	24.6	0.0026	0.0022	0.0081	368.1	466.8
5	750	2250	50	250	250	623.7	623.7	358.9	26	0.0079	0.0076	0.0081	368.6	783.6
6	625	600	30	100	100	293.2	293.2	208.9	23.5	0.0023	0.0021	0.0251	0	49
7	625	600	30	100	100	293.2	293.2	208.9	27.2	0.0023	0.0021	0.0251	29.4	66.2
8	625	600	30	100	100	293.2	293.2	208.9	26.9	0.0023	0.0021	0.0251	62.9	76
9	625	600	30	100	100	293.2	293.2	208.9	25.7	0.0023	0.0021	0.0251	125.4	86.3
10	575	600	30	100	100	261.8	261.8	212.8	18.6	0.0024	0.0024	0.0252	0	34.3
11	575	600	30	100	100	261.8	261.8	212.8	18.6	0.0024	0.0024	0.0252	0	36.8
12	625	600	30	100	100	293.2	293.2	208.9	29.9	0.0023	0.0021	0.0252	63	58.8
13	625	600	30	150	100	475.6	475.6	276.2	25.2	0.0021	0.002	0.0272	0	72.6
14	625	600	30	150	100	475.6	475.6	221.1	28.3	0.0021	0.002	0.0261	41.3	68.6
15	625	600	30	150	100	475.6	475.6	221.1	28	0.0021	0.002	0.0261	82.2	78.5
16	625	600	30	150	100	475.6	475.6	221.1	29	0.0021	0.002	0.0261	123.7	102
17	1200	2300	75	250	250	335.4	335.4	467.8	23.2	0.0019	0.0019	0.0255	0	966
18	1200	2300	80	250	250	335.4	335.4	467.8	33	0.0018	0.0018	0.0255	0	931.6
19	1200	1550	80	250	250	485.4	485.4	467.8	17.4	0.0017	0.0018	0.0255	0	608
20	150	430	30	150	30	0	0	382.5	22.5	0	0	0.0068	0	24.9
21	150	430	30	150	30	382.5	382.5	382.5	22.5	0.0036	0.0041	0.0068	0	20.7
22	150	430	30	150	30	382.5	382.5	382.5	16.9	0.0036	0.0041	0.0068	0	17.4
23	150	430	30	150	30	333.4	333.4	382.5	16.9	0.0037	0.0042	0.0068	0	19.1

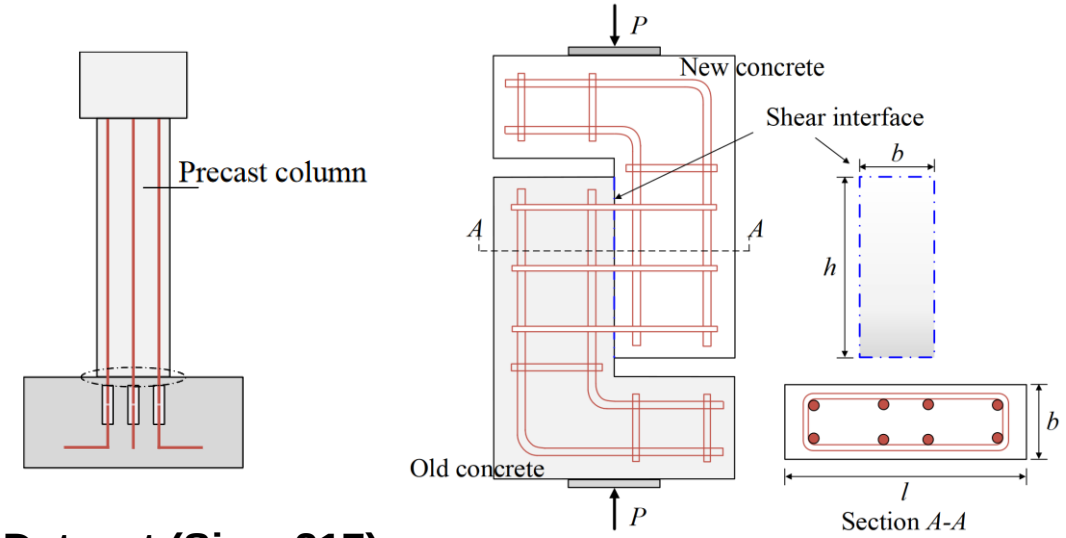
Feature (Input Variables)

类别	变量符号(单位)	描述
几何尺寸	h_w(mm)	高度(height)
	l_w(mm)	长度(length)
	t_w(mm)	腹板厚度(web thickness)
	b_f(mm)	凸缘高度(flange height)
	t_f(mm)	凸缘厚度(flange thickness)
材料特性	f_{yv}(MPa)	腹板竖向钢筋强度(vertical web reinforcement strength)
	f_{yh}(MPa)	腹板水平钢筋强度(horizontal web reinforcement strength)
	f_{yL}(MPa)	纵筋强度(longitudinal reinforcement strength)
	f_c'(MPa)	混凝土抗压强度(concrete compressive strength)
钢筋布置	ρ_v(%)	腹板竖向钢筋配筋率(vertical web reinforcement ratio)
	ρ_h(%)	腹板水平钢筋配筋率(horizontal web reinforcement ratio)
	ρ_L(%)	纵筋配筋率(longitudinal reinforcement ratio)
施加荷载	P(kN)	竖向荷载(applied axial load)

Target (Output Variables)

变量符号（单位）	描述
V_u (kN)	抗剪强度(shear strength)

数据集5：新旧混凝土界面抗剪强度预测



Dataset (Size: 217)

#	fy	db	nb	ρ	fcmax	fcmin	b	h	Surface Type	τ
1	572.0	9.5	2	0.00370	98.80	98.80	127.0	304.8	S	3.65
2	572.0	9.5	4	0.00740	83.10	83.10	127.0	304.8	S	5.66
3	572.0	9.5	2	0.00366	80.90	80.90	127.0	304.8	R	6.20
4	572.0	9.5	4	0.00740	80.90	80.90	127.0	304.8	R	9.43
5	572.0	9.5	6	0.01110	86.00	86.00	127.0	304.8	R	12.67
6	572.0	9.5	8	0.01480	86.00	86.00	127.0	304.8	R	15.25
7	572.0	9.5	6	0.01110	89.30	89.30	127.0	304.8	R	13.09
8	572.0	9.5	8	0.01480	89.30	89.30	127.0	304.8	R	14.48
9	572.0	9.5	2	0.00370	101.70	101.70	127.0	304.8	R	10.45
10	572.0	9.5	4	0.00740	101.70	101.70	127.0	304.8	R	11.40
11	572.0	9.5	6	0.01110	104.90	104.90	127.0	304.8	R	15.48
12	572.0	9.5	8	0.01480	104.90	104.90	127.0	304.8	R	17.59
13	446.0	8.0	6	0.00502	65.65	56.64	200.0	300.0	S	4.21
14	446.0	8.0	6	0.00502	65.65	56.64	200.0	300.0	S	3.61
15	446.0	8.0	6	0.00502	65.65	56.64	200.0	300.0	S	3.53
16	446.0	8.0	6	0.00502	65.65	56.64	200.0	300.0	S	3.46
17	446.0	8.0	6	0.00502	65.65	56.64	200.0	300.0	S	3.54

Feature (Input Variables)

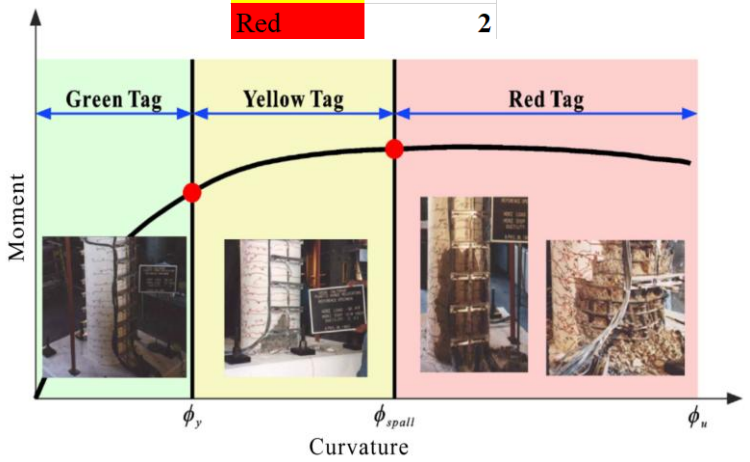
变量符号（单位）	描述
f_y(MPa)	抗剪钢筋屈服强度(yielding strength of the shear reinforcements)
d_b(mm)	抗剪钢筋直径(diameter of the shear reinforcements)
n_b	抗剪钢筋数量(number of bars of the shear reinforcements)
ρ	抗剪钢筋配筋率，抗剪钢筋面积和/截面面积(reinforcement ratio)
f_{max}(MPa)	新旧混凝土两者中，较高的抗压强度(the larger concrete strength)
f_{min}(MPa)	新旧混凝土两者中，较低的抗压强度(the lower concrete strength)
b(mm)	界面宽度(interface section width)
h(mm)	界面长度(interface section length)
Sur_{tupe}	界面的表面类型（S:光滑 R:粗糙）(surface type of the interface (S: smooth, R: roughened))

Target (Output Variables)

变量符号（单位）	描述
τ(MPa)	界面抗剪强度(interface shear strength)

数据集6：桥梁震后损伤状态预测

Tag	
Green	0
Yellow	1
Red	2



Dataset (Size: 480)

#	Sa10 (g)	EQ dir	Fc (MPa)	Fy (MPa)	Lm (m)	WDeck (m)	LCol (m)	pl	Kft (kN/mm)	KfrT2KftL	KfrT (GN-m/rad)	Habut (m)	Kabut (kN/mm)	soil type	Kbearing (N/mm2)	COF	Damp	MassFacti	GapL (mm)	GapT (mm)	ShrKey (g)	Tag
1	0.17052	2	30.6939	469.087	44.9715	18.2475	7.91552	0.02535	422.816	1.29588	0.81659	5.44473	0.19955	2	0.44248	0.24195	0.05462	1.08726	10.7747	3.59044	1.09704	0
2	0.42771	1	37.2642	533.617	60.1409	17.8091	6.48609	0.01607	179.524	0.7861	3.26939	3.84668	0.13789	2	0.31294	0.16498	0.06154	1.0192	10.8154	0.78323	0.99012	2
3	0.44443	2	26.8348	431.185	30.5719	17.3864	8.32309	0.02704	128.194	1.12408	0.93462	3.82777	0.13658	2	1.13434	0.45116	0.03582	1.02148	42.8706	35.2819	0.91363	1
4	0.36261	1	25.6598	419.645	41.4089	17.4332	8.21938	0.02666	368.344	1.09599	2.67267	3.58268	0.12009	2	0.84526	0.38579	0.04204	1.06127	15.8214	11.1353	1.19579	2
5	0.36278	2	31.2847	474.89	53.4447	19.7299	6.24641	0.01454	83.1404	0.78911	2.83509	4.05157	0.15253	2	0.81076	0.37652	0.04923	0.99222	18.0788	14.8488	1.08901	2
6	0.09835	2	34.1311	502.845	39.8128	17.0684	7.90833	0.02532	189.279	0.71665	1.57214	4.20231	0.16376	2	0.6349	0.32219	0.03213	1.12133	38.3785	33.9016	1.12437	0
7	0.77285	1	37.1295	532.293	26.0568	18.1179	6.87817	0.01883	100.933	0.73309	2.98875	4.07194	0.15403	2	0.54018	0.28629	0.03753	0.95128	8.75226	1.59018	1.08226	0
8	0.22036	1	32.1463	483.351	26.6083	17.5038	6.31401	0.01495	215.091	1.08206	0.5938	3.55009	0.11797	2	0.329	0.1761	0.0475	1.0032	34.9205	32.3869	1.00248	1
9	0.52319	1	31.4579	476.59	36.989	16.423	7.16259	0.02084	126.96	0.96062	1.16596	4.47916	0.18539	2	0.78235	0.3686	0.02812	1.06177	15.6233	10.8078	0.87301	2
10	0.12692	2	29.5574	457.925	56.641	16.8259	5.52903	0.01131	389.119	1.01348	0.92502	3.9287	0.14367	2	0.33727	0.18161	0.05415	1.13844	27.9643	27.5537	0.99928	1
11	0.25271	2	26.2634	425.573	38.5202	16.773	9.73787	0.01036	234.608	1.33068	1.11551	3.17682	0.09505	1	0.62704	0.31942	0.06003	1.10085	30.5322	29.6713	0.87519	1
12	0.34247	1	31.9499	481.423	55.3774	17.1728	5.38258	0.01093	164.021	1.0912	0.91161	3.43054	0.11037	1	0.98961	0.34188	0.05948	1.12223	27.7129	27.3221	1.03765	2
13	0.20429	1	24.993	413.096	52.5075	18.8913	6.95391	0.01937	126.402	1.40244	0.75355	3.31643	0.10335	1	0.35452	0.1927	0.02457	1.10578	17.9942	14.7118	1.0218	2
14	0.15519	1	29.4465	456.836	53.8998	20.0808	6.58612	0.01676	86.9572	0.69792	0.61589	3.44165	0.11107	1	0.59633	0.30826	0.0627	1.10217	24.5447	23.9978	1.14066	2
15	0.13762	1	29.5946	458.29	29.2761	18.7165	7.19667	0.02108	160.518	0.89453	0.76882	3.23069	0.09821	1	0.76468	0.36352	0.0425	0.99404	19.3274	16.832	1.10411	0
16	0.52759	2	31.9597	481.518	37.9049	16.6323	6.95964	0.01941	142.821	1.19346	0.55273	4.13146	0.15844	2	0.58546	0.30417	0.03884	0.96548	23.3731	22.5696	0.83013	2
17	0.14496	2	33.3252	494.93	41.9502	17.557	9.16221	0.029	244.336	0.87906	2.75211	3.41871	0.10963	1	0.71951	0.44637	0.06121	0.95874	12.5932	6.01542	1.14836	0
18	0.75579	2	33.2592	494.282	39.0284	16.8891	7.36551	0.02221	103.534	0.958	1.9873	3.64325	0.12407	2	0.3981	0.21847	0.04565	1.0052	35.3716	32.6119	1.14853	2
19	0.52071	1	34.0295	501.847	43.1374	17.8283	6.91674	0.01911	278.786	0.99844	0.86529	3.90866	0.14225	2	0.44606	0.24374	0.04221	1.10644	41.1932	34.8308	1.02751	2
20	0.16808	2	31.076	472.84	47.804	18.895	6.85562	0.01867	191.337	1.23688	1.84948	3.3095	0.10293	1	0.46387	0.25244	0.06015	0.96437	20.4017	18.4686	0.93707	0
21	0.33491	1	31.5671	477.663	41.6915	17.4978	9.05649	0.02884	212.333	1.34812	0.66223	4.21998	0.1651	2	0.52271	0.27898	0.05174	1.05135	25.651	25.2465	0.89297	0
22	1.24886	1	30.4886	467.071	38.7277	16.8204	8.36014	0.02716	356.778	0.84703	1.553	3.55413	0.11824	2	1.00743	0.42479	0.05183	1.01577	15.5282	10.6508	0.99347	2
23	0.18723	2	28.1784	444.381	56.8173	16.2521	5.88006	0.0296	363.013	1.29224	1.47263	3.85846	0.13872	2	0.34741	0.1882	0.04338	1.02988	25.9006	25.5149	1.1079	1
24	0.4131	2	35.8945	520.164	48.7468	19.1105	7.94731	0.0255	412.386	1.02258	1.71121	3.05573	0.08814	1	0.75501	0.36069	0.05552	1.08939	20.7785	19.0247	1.15294	2
25	0.68524	1	32.7033	488.822	60.7376	17.2982	6.20475	0.01429	97.5825	0.97873	1.51837	4.44557	0.1827	2	1.29244	0.48015	0.03028	0.958	22.242	21.0877	1.06236	2
26	0.29963	1	32.9243	466.045	34.0905	15.7605	9.14494	0.02898	102.114	0.96427	1.37743	3.18478	0.09552	1	0.48562	0.26263	0.06242	1.03588	17.2823	13.5499	0.95491	0
27	0.31573	2	27.6617	439.306	54.5928	19.4587	5.27001	0.0107	272.988	0.96596	1.51568	3.75011	0.13124	2	0.69105	0.34102	0.04144	1.00419	13.091	6.75566	0.85024	2
28	0.24622	2	28.4898	447.439	48.1775	18.9803	6.25418	0.01458	350.751	1.27792	1.78194	3.46966	0.11283	1	0.48923	0.26427	0.04086	1.07663	54.8125	37.9178	0.87	2
29	0.2262	2	32.8455	490.219	46.765	18.6575	5.88873	0.01264	304.858	0.92619	1.46667	3.63271	0.12337	2	0.59207	0.30667	0.05291	0.98348	25.1504	24.6934	1.12895	1

Feature (Input Variables)

变量符号	描述（中文、英文）
Sa10 (g)	1s 周期处的谱加速度 Spectral Acceleration at 1.0s
EQ(dir)	地震方向（与断层 1.垂直或 2.平行）Earthquake direction (fault-normal or parallel)
$F_c(Mpa)$	混凝土抗压强度 Concrete compressive strength
$F_y(Mpa)$	钢筋屈服强度 Rebar yield strength
Lm (m)	桥梁跨径 Span length
WDeck(m)	主梁宽度 Width of the deck
Lcol(m)	桥墩高度 Clear height Column
$\rho_l(/)$	桥墩主筋配筋率 longitudinal reinforcement ratio
Kft(KN/mm)	群桩基础平移刚度 Translational stiffness
KfrT2KftL(/)	群桩基础横向/纵向转动刚度比 Transverse/longitudinal rotational stiffness ratio
KfrT(GN m/rad)	群桩基础横向转动刚度 Transverse rotational stiffness
Habut (/)	桥台背墙高度 Abutment backwall height
Kabut(/)	桥台桩基础水平刚度 Pile stiffness
soil(type)	桥台回填土类型 Backfill type (1. Sand, 2. Clay)
Kbearing(/mm2)	支座水平刚度 Bearing stiffness per deck width
COF(/)	支座摩擦系数 Coefficient of friction of bearing pad
Damp(/)	阻尼比 Damping ratio
Mass(/)	质量系数 Mass factor（考虑桥梁附属非结构构件的质量）
GapL(mm)	桥台与主梁纵向间隙 Longitudinal gap (pounding)
GapT(mm)	桥台与主梁横向间隙 Transverse gap (shear key)
ShrKey(g)	表征挡块抗剪能力的加速度 Acceleration for shear key capacity

Target (Output Variables)

变量符号	描述（中文、英文）
Tag	0：绿色 Green；1：黄色 Yellow；2：红色 Red